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Self-diffusion in a hyaluronic acid-albumin-water system as studied by NMR

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Abstract

Hyaluronic acid (HA) is an anionic biopolymer that is present in many tissues and can be involved in cancerous neoformations. HA can form complexes with proteins (particularly, serum albumin) in the body. However, HA structures and processes involving HA have not been extensively studied by NMR because the molecule's rigid structure makes these studies problematic. In the current work, self-diffusion of HA and bovine serum albumin (BSA), and water in solutions was measured by 1H pulsed field gradient NMR (PFG NMR) with a focus on the HA-BSA-D 2O systems at various concentrations of BSA and HA. It was shown that in the presence of even a small amount of HA, the self-diffusion coefficient (SDC) of BSA decreases. To explain this fact, three hypotheses were proposed and analyzed. The first one was based on the effect of slowing down of water mobility in the presence of HA. The second hypothesis suggested an effect of mechanical collisions of BSA with HA molecules. The third hypothesized that BSA and HA molecules form a complex where BSA molecules reduced in mobility. It was shown that the third mechanism is the most likely. The state of the BSA molecules in the BSA-HA-D 2O system corresponds to a 'fast exchange' condition from the NMR point of view: BSA molecules reside in the 'free' and 'bound' (with HA) states for much shorter time than the diffusion time of the PFG NMR experiment, 7ams. The fractions of 'bound' BSA molecules in the BSA-HA complex were estimated.

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Keywords

nuclear magnetic resonance, self-diffusion